National Air Monitoring Strategy

[Overview for CASAC PM monitoring subcommittee; 1/28/02]

STAPPA/ALAPCO

EPA Office of Air Quality Planning and Standards

Tribes

Topics

- Basics of the strategy…why, what, process
- Network assessments
- New directions/design
- Link to continuous monitoring

Why?

- Outdated design/lack of integration
  - Monitoring regulations from 1970's
  - Air quality issues different today
    - Major changes in composition and concentrations
    - Technology for 70's issues ..relevancy for now?
  - Value of certain data components (so many low level readings, PAMS..)
  - Separate program by program add on
    - NAMS/SLAMS; PAMS; PM2.5; HAPs; PMc
- Capacity (S/L/T workforce) can not keep up with demands
  - PAMS..then PM2.5..then HAPS…then PMcoarse…
  - Frustration from S/L agencies
- Several years of scientific findings, new technologies
  - need to be incorporated , non response yields other frustrations…
- ***Begging for optimization, rethinking, modification***

Major strategy elements

- ***Network Assessments***
- ***Core National Network redesign emphasizing integration***
- *Technology…this meeting*
  - Enhancement of advanced monitors (cont. PM case example)
  - Improved information transfer
- Regulations modifications
- Quality Assurance
- Communications

National Monitoring Strategy Committee

National Monitoring Strategy Committee (NMSC)

- Representatives (16) from States, local agencies, Tribes and EPA
  - Include leadership across monitoring programs and air program management
- Provided overall direction and endorsement for the strategy.

Major NMSC summary statements

- *The nations ambient air networks require significant **change from the current focus on "NAAQS compliance"** and criteria pollutants with numerous single measurement labor intensive sites.*
- *Moderate to substantial **disinvestments in traditional criteria pollutant** monitoring are recommended in recognition of progress made towards abating levels of CO, Pb, NO2,PM10 and SO2 over the last two decades.*
- *An efficient multi-pollutant integrated network utilizing **automated technology** to deliver timely information to the public, air quality management and research professionals is essential to fulfill future needs.*
- *Specific technology enhancements are recommended to increase the nation's capacity to measure non-criteria hazardous air pollutants and **continuously reading particulate matter**.*
- *The nation's networks must be **assessed** at regular intervals to insure their relevancy to current priorities and technologies.*

Network Assessments

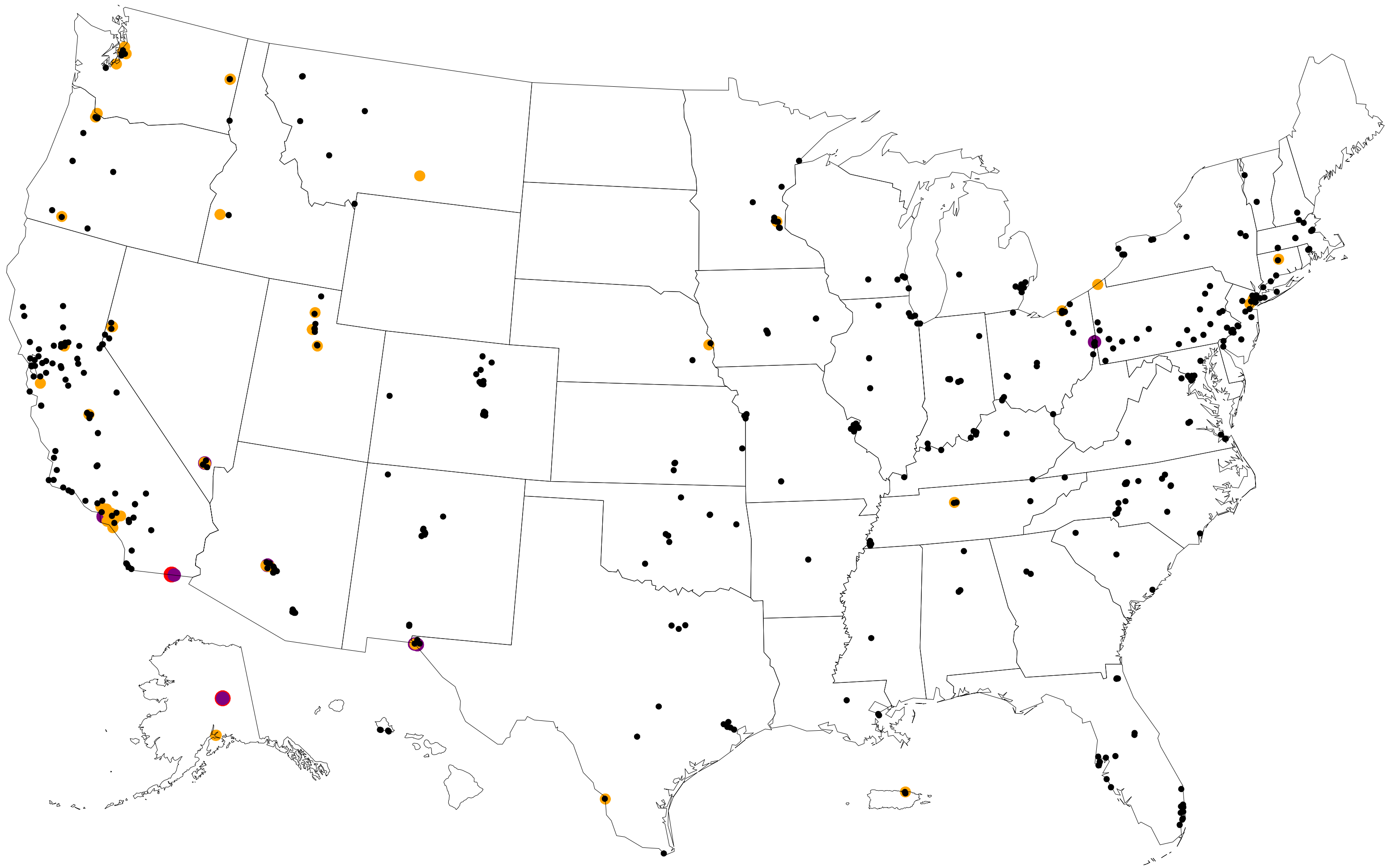
- Reviewing relevancy/adequacy of networks and attempts at optimization
  - Eliminating unnecessary redundancies
  - Identifying needed additions
- National assessments
  - Produce motivation/basis for more regionalized/local efforts
  - Spurring use of spatial optimization, mapping tools for network design
- Regional assessments
  - Supercede national results and provide direct guidance for network modification
- Regional assessments completed by end of 2002, then iterated

Assessment examples…skip to slide 28 if needed
we will skip

Broad view

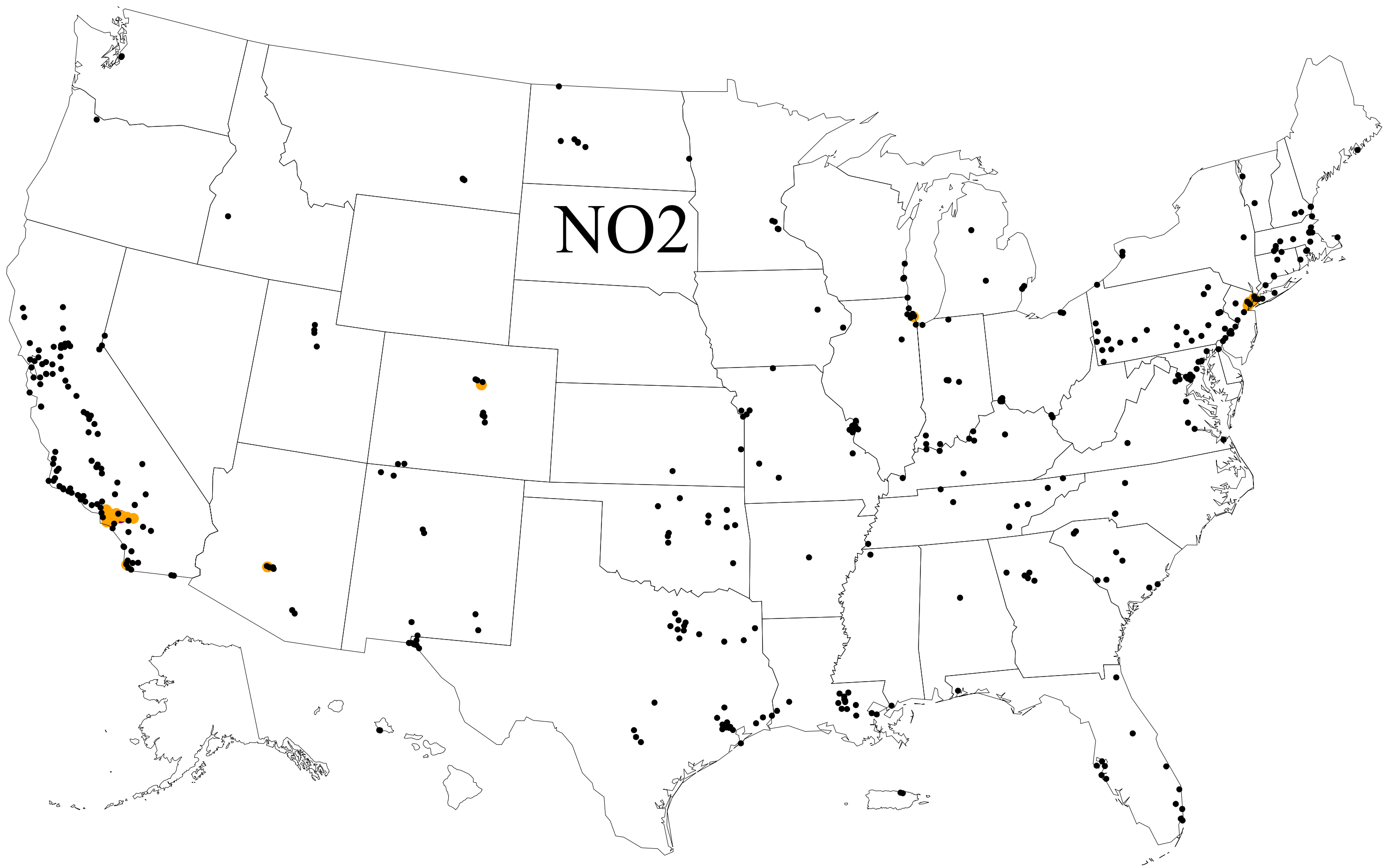
- Relevancy for NAAQS comparisons

Figure 3: 8-Hour CO 2nd Max - Percent of NAAQS: Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%



8-Hour CO 2nd Max Percent of NAAQS:Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%

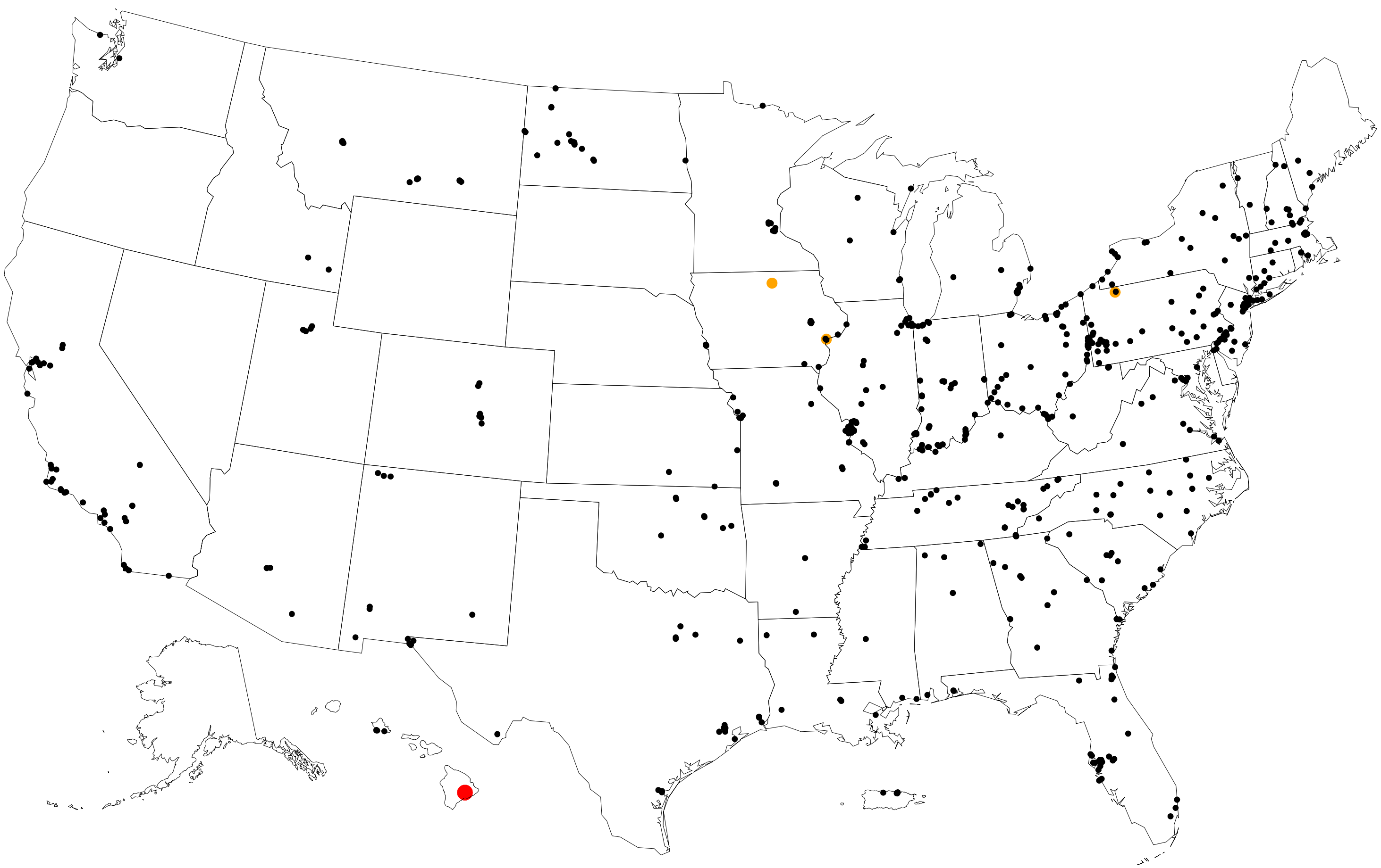
Figure 4: NO2 Annual Mean - Percent of NAAQS: Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%



NO2 Annual Mean Percent of NAAQS:Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%

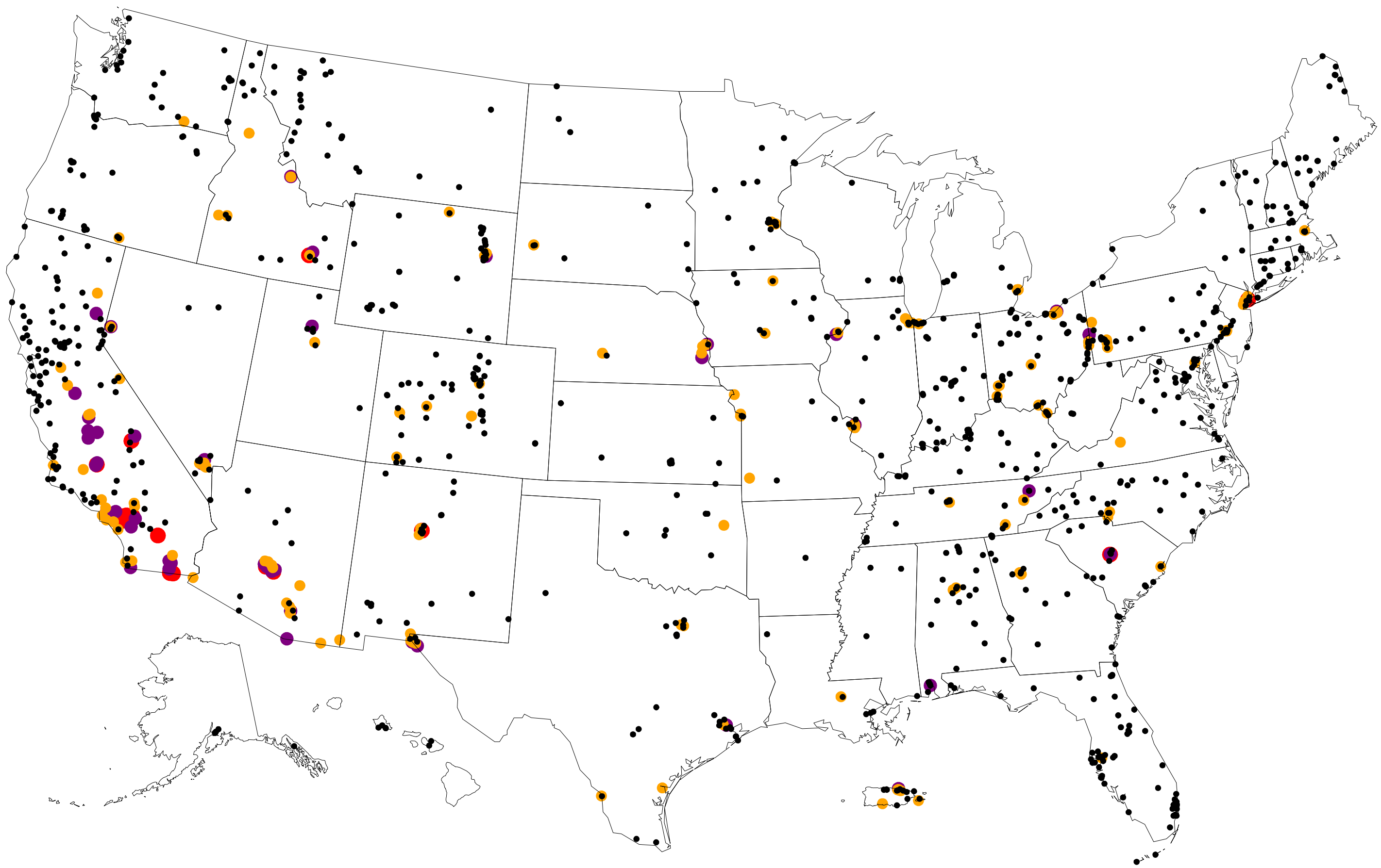
Figure 5: SO2 2nd Max - Percent of NAAQS:

Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%



SO2 2nd Max Percent of NAAQS:Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%

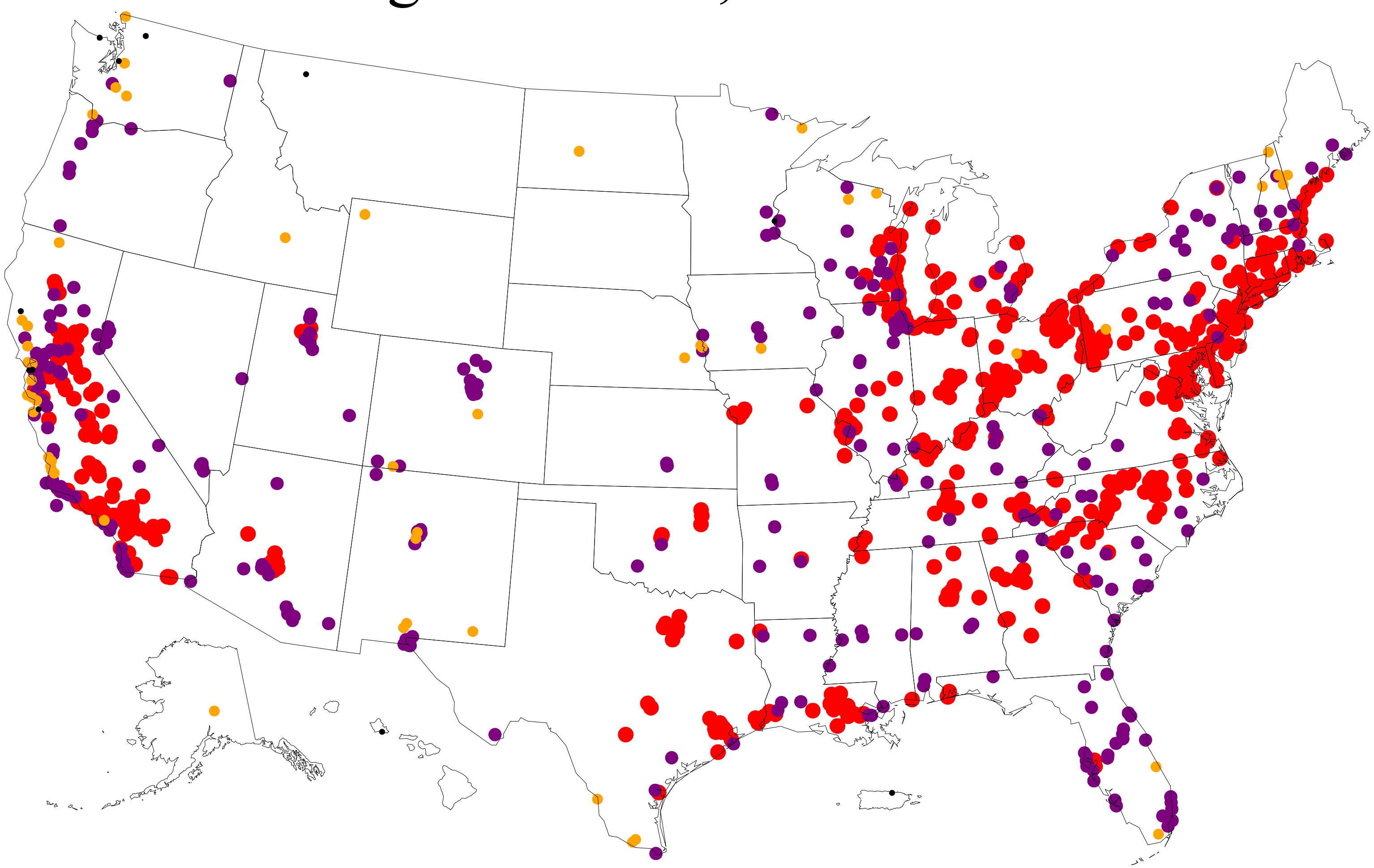
Figure 7: PM10 Annual Mean - Percent of NAAQS: Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%



PM10 Annual Mean Percent of NAAQS:Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%

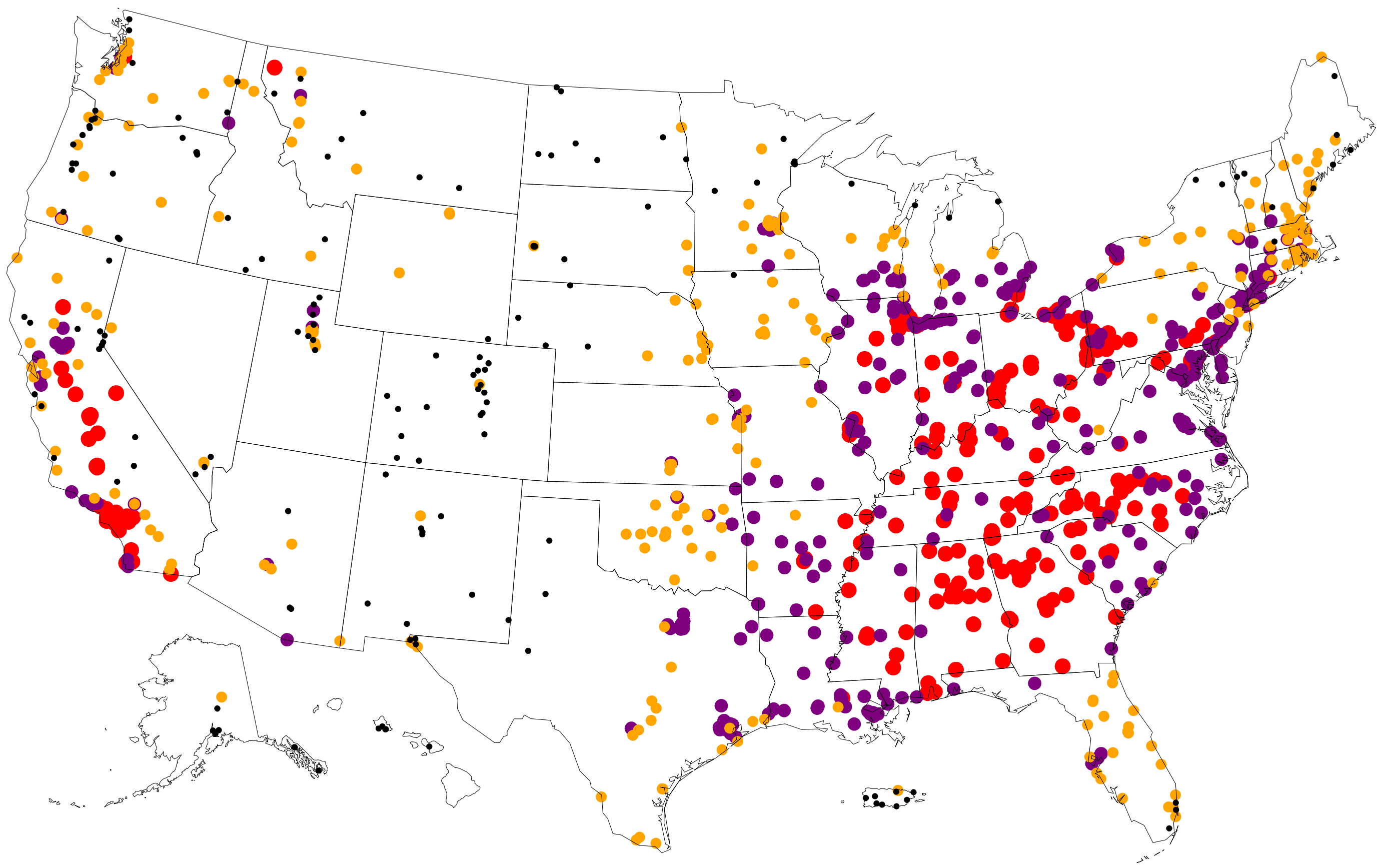
2 pollutant emphasis

Figure 1: 98-00 8-Hour O3 4th Max - Percent of NAAQS: Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%



95-97 8-Hour O3 2nd Max Percent of NAAQS:Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%

Figure 2: PM25 Annual Mean - Percent of NAAQS: Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%



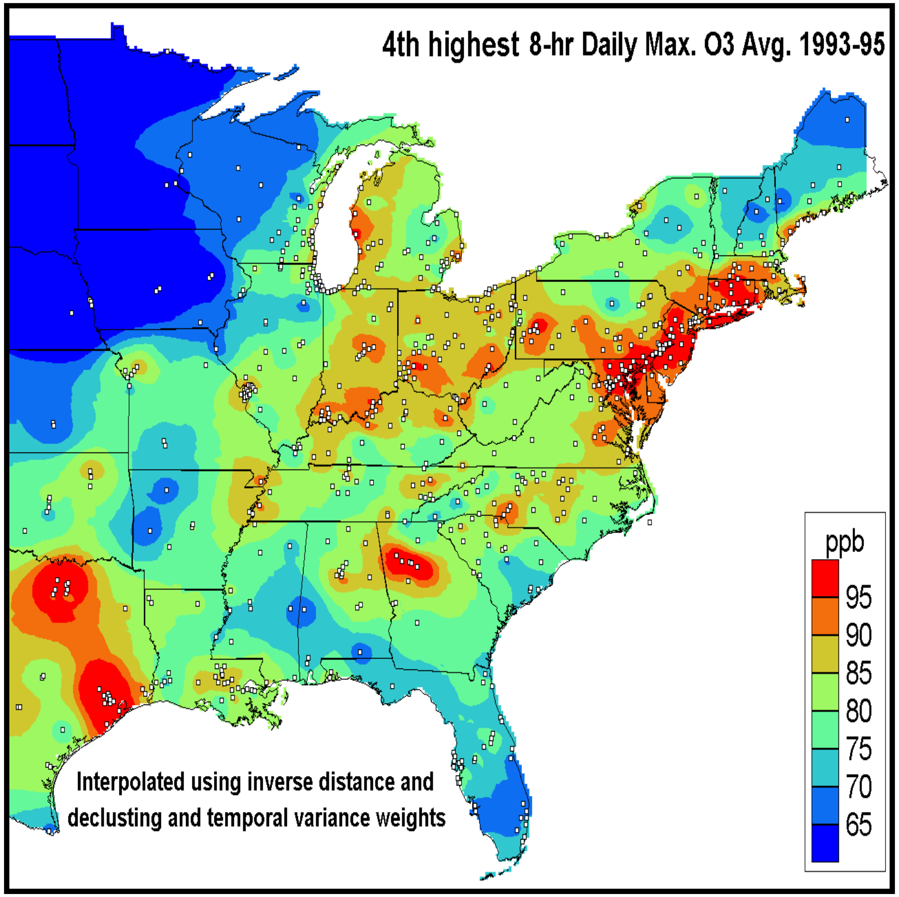
PM25 Annual Mean Percent of NAAQS:Red= >100%, Purple= 80-100%, Orange= 60-80%, Black= <60%

Introducing value based approaches

- National Assessment
  - Coop EPA/Washington U. (Husar)

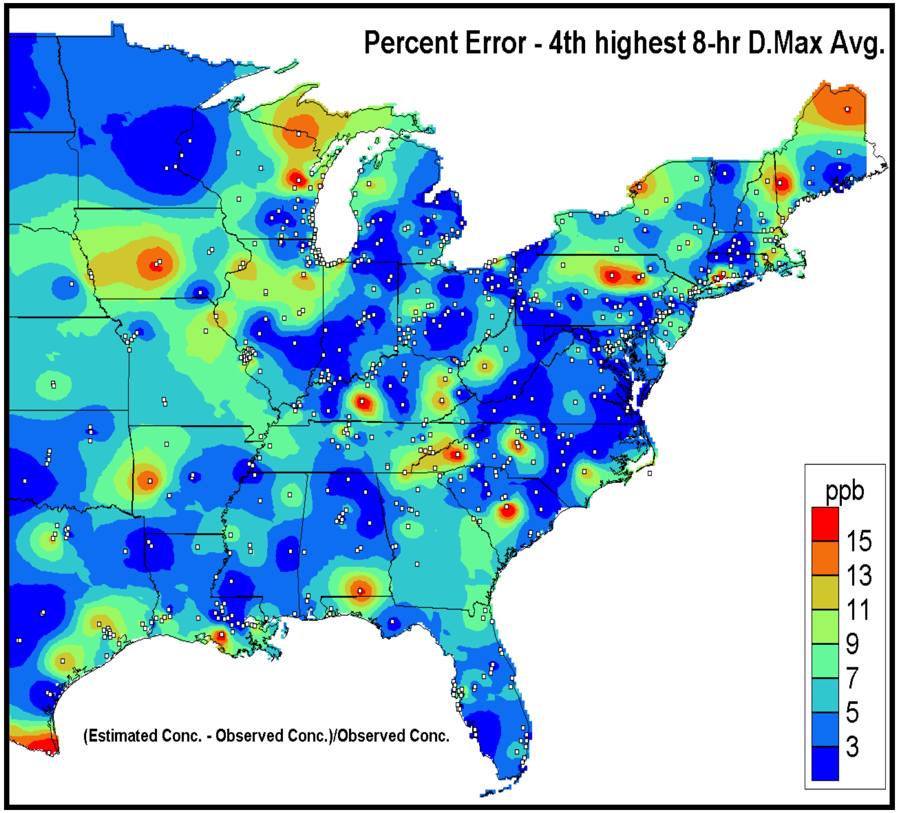
4th Highest Ozone Concentration

- There are over 700 ozone monitoring sites over the Eastern US
- The AIRS sites are clustered mainly in urban-metropolitan areas
- The CASTnet sites cover rural regions
- The concentration metric used were the 4th highest daily 8 hr average during 1993-95



Concentration Error, E

- The concentration error is determined by
  - selectively removing each site from the database
  - estimating the concentration at that site by spatial interpolation
  - Determining E as the difference between the actual measured and estimated value



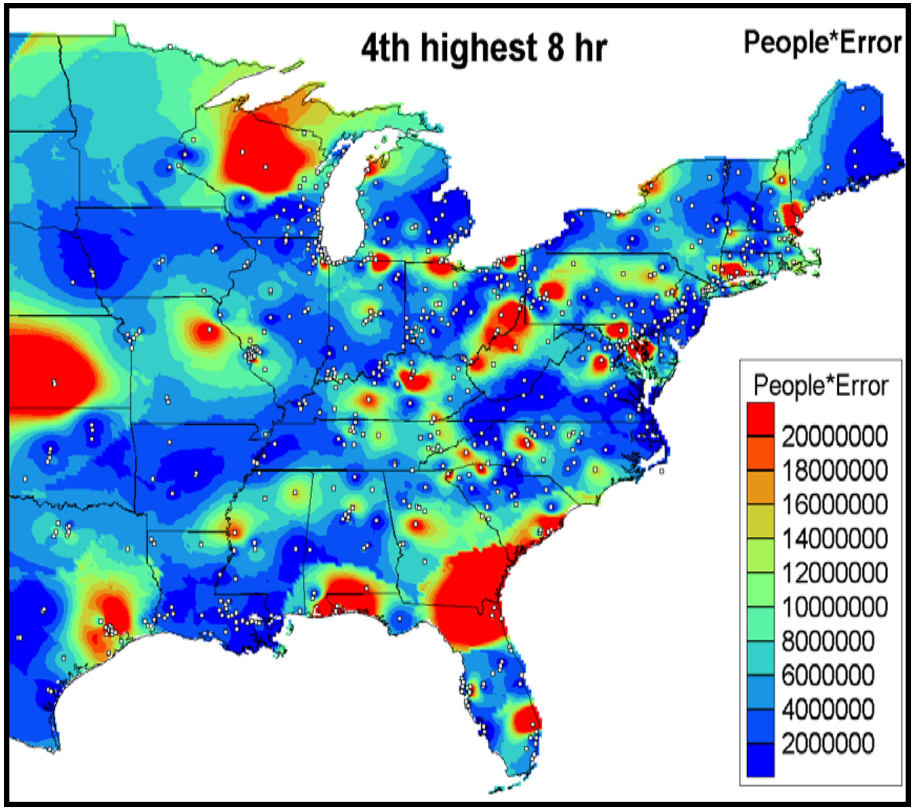
The error estimates in both metric of ozone concentration over the Eastern US ranges between 0-15 %.

High estimation error is generally observed over areas with low station density.

Low error generally occurs over areas with high station density

Station Information Value Maps

- The station information value was calculated from the concentration error, E, weighed by the # of persons in the station zone: $I = E \times W$



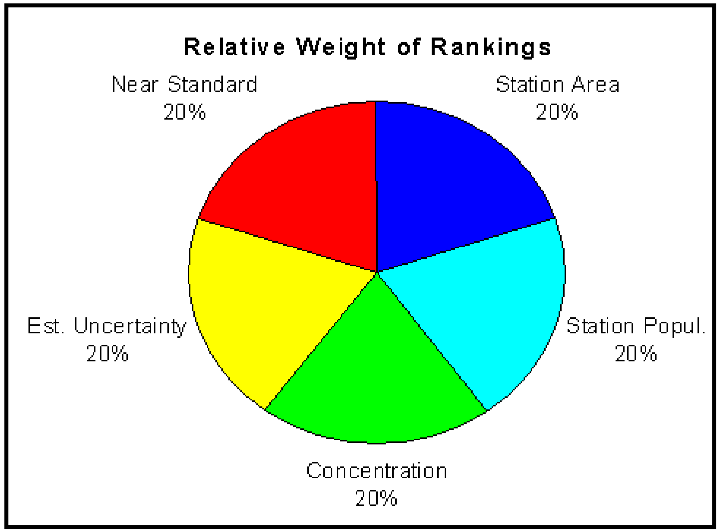
According to the above evaluation metric, ozone sites in the Southeast (Florida-S.Carolina), Texas, Kansas, Minn.-Wisconsin have **high** information value.

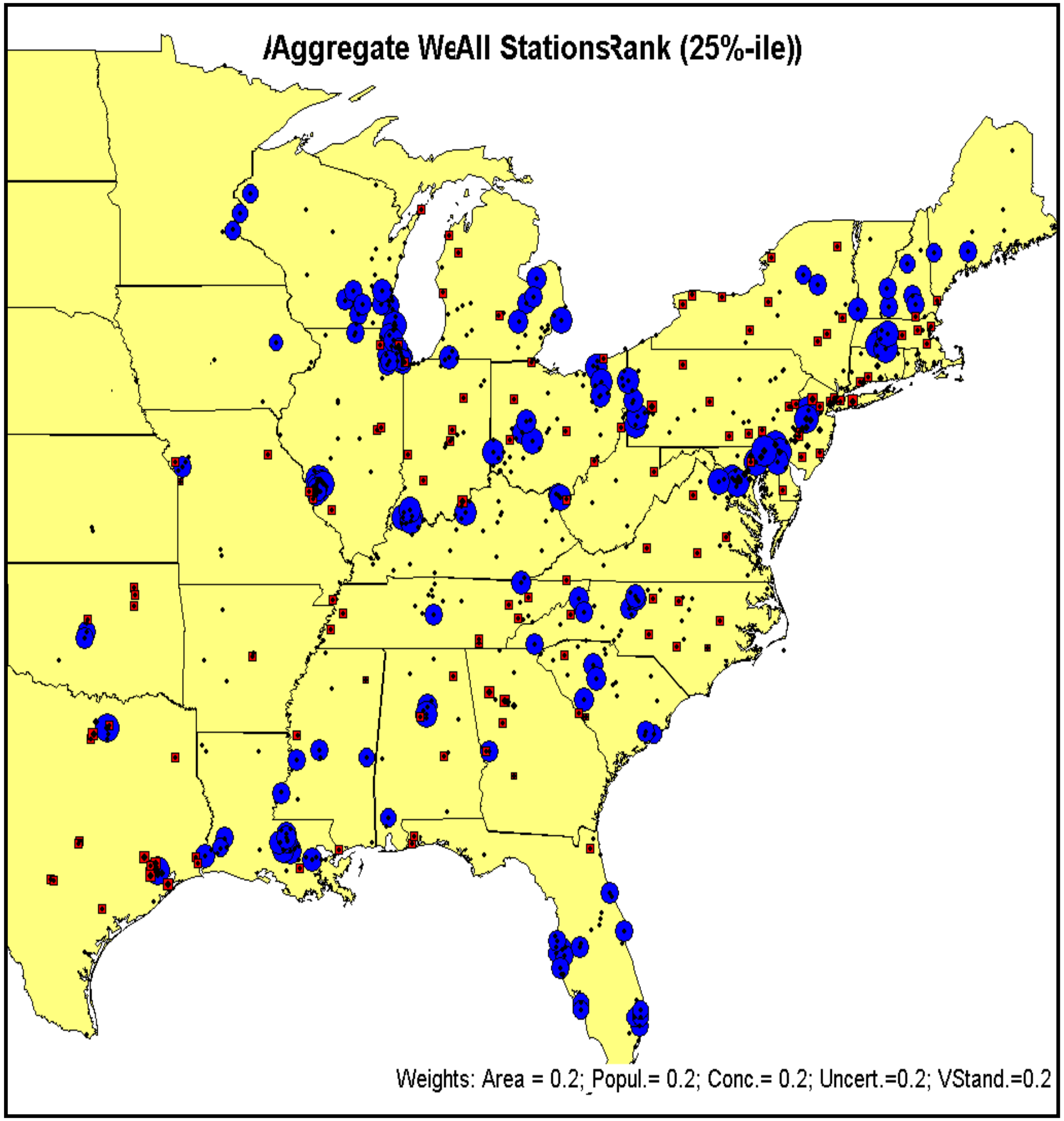
Sites in the Illinois-Ohio zone, N. Carolina, Louisiana and others have **low** ozone information value

Additional Factors, example

Aggregate Ranking – Example **Equal Weight**

- All five measures are weighed equal at 20% each.
- High 'aggregate value' stations (red) are located over both urban and rural segments of the central EUS.
- Low 'value' sites (blue) are inter-dispersed with high value sites.
- Clusters of low value sites are found over Florida, Upper Midwest, and the inland portion of New England.



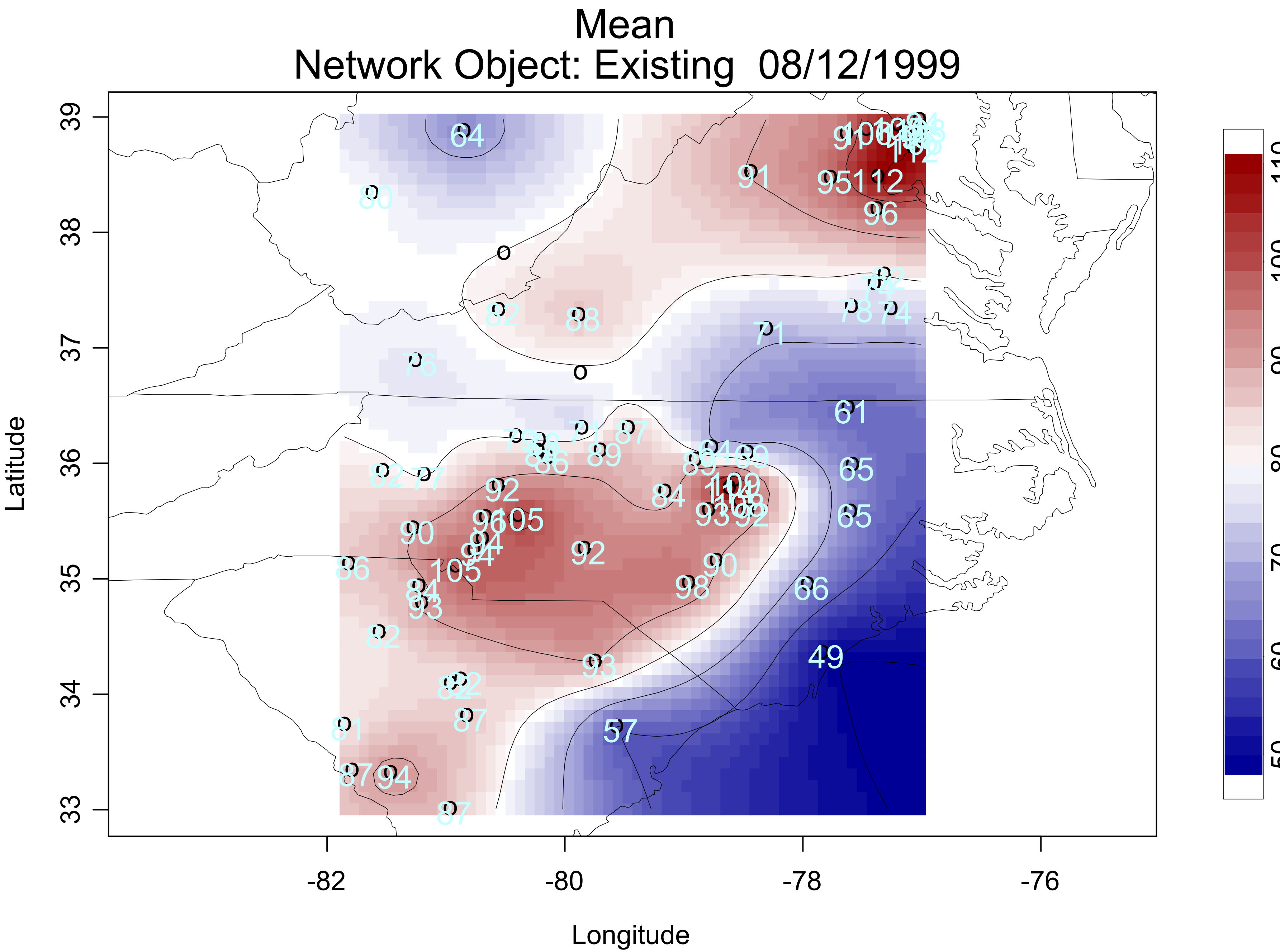


Summary of National Assessment Results

- Ozone
  - Limited reductions nationally (5 - 30%) with an emphasis on relocation to enhance mapping, rural/regional concentrations, possible increases to assist in coverage in southeast and Texas.
- PM2.5 FRM
  - Moderate reductions (20-30% to ~ 800 sites) after 3 years data collected coinciding with a shift to continuous methods for AQI/mapping; eventual 500 site (or smaller) FRM network with total network of 800-1100 sites (filter and cont.) to support spatial needs (napping AQI and regulatory)
- PM10
  - Major reductions from 1600 site network (1996) dependent on Regional/State rqmts., consequences of PMcoarse
- CO, NO2, SO2
  - Major reductions for NAAQS purposes; switch to representative and high sensitivity techniques for model evaluation/obs techniques, build into new core sites
- Lead
  - Declare victory!….minimal trends…emphasis as a HAP metal
- PAMS
  - Restructure. Reduce "minimum" requirements.

Example additional assessment/network optimization tools

- Design Interface…NCAR [next example]
- Entropy minimization (NC State, Fuentes)
- Integrated model/observation (Cimorelli, EPA R3)
- Other error minimization variants (Rizzo, EPA R5)
- Spatial analysis workshop, 12/01
  - Subsequent model testing/applications


Mean
Network Object: Existing 08/12/1999
Latitude
Longitude
39
38
37
36
35
34
33
-82
-80
-78
-76
110
100
90
80
70
60
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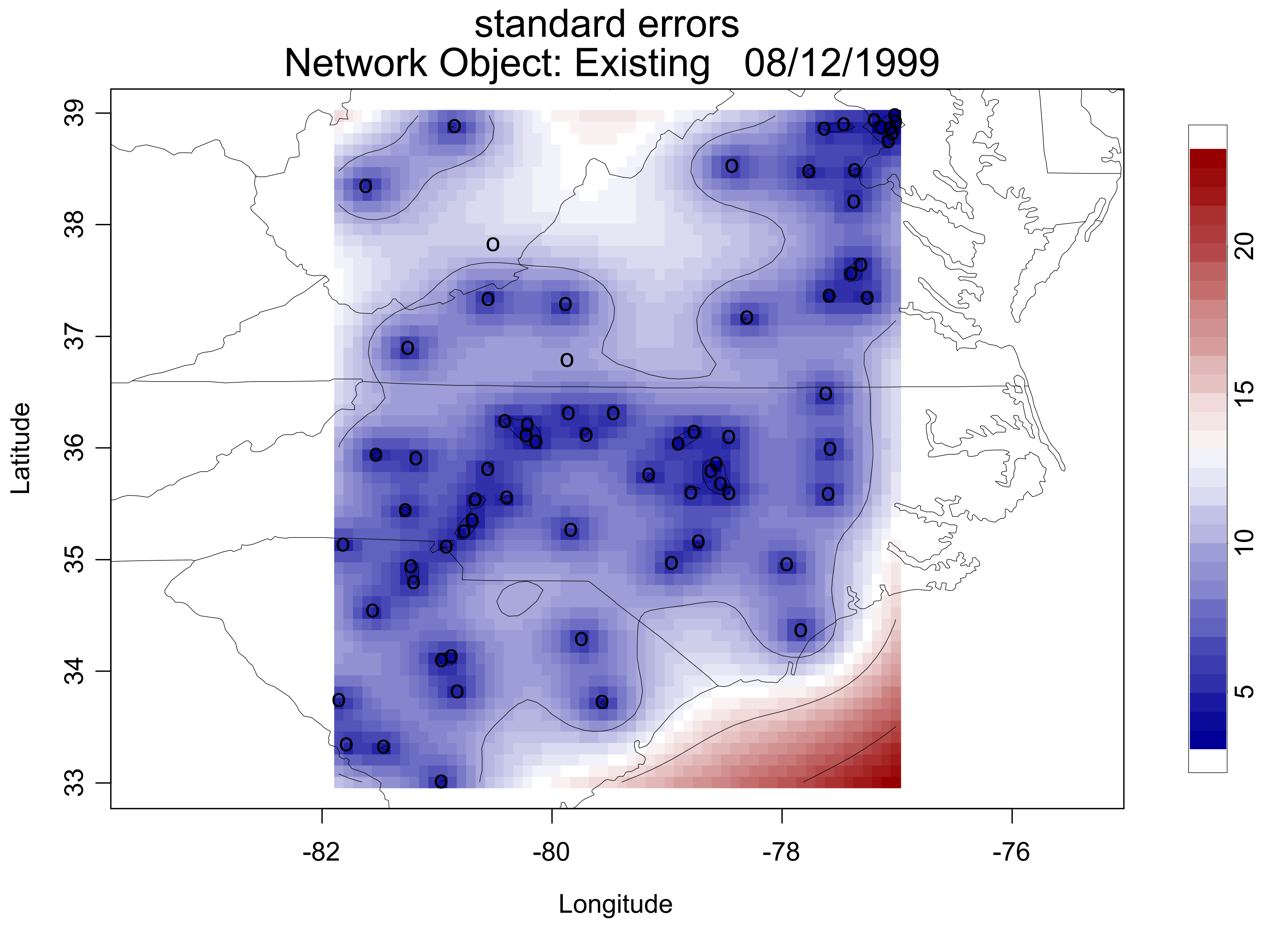
standard errors
Network Object: Existing 08/12/1999
Latitude
Longitude
39
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34
33
-82
-80
-78
-76
20
15
10
5

Regional Assessments

- Draft results from R5/LADCO
- Tool development Region 3
- Various stages of progress in other Regions
- Initial results October/02
- Iterative…part of regular review practices
- Broad guidance

Policy Connection

- Interpreting boundaries for emission strategy areas
  – Moving away from single monitor and associated discontinuities to contiguous surfaces
  – Using mapped data to represent “gaps” and define spatial surfaces…(implementing FACA concepts..AOI, AOV)
- Midwest and Region 3 examples…forcing issue…
- Science need
  – Support to maximize use of spatial surfaces
    - Spatial workshop….12/01…RTP

NCore [draft]

- The following slides do not reflect NMSC consensus….start….

National Core Network (NCore) [draft]

- Address major “national” objectives through NCore
- Includes recommendations for “desired” modifications
  - Under level resource constraint…realistic
  - Add collocated multi-pollutant component
  - In some cases…mini Supersites (more discussion)
- Consolidate CFR58 monitoring regs under NCore

  (e.g.; PAMSCore, MAP(NAMS)Core, HAPSCore, SPECCore)
  - build on existing networks

National Objectives [draft]

- Timely Public information dissemination
  - Entails near real time characterization of most important pollutants (ozone, PM2.5) for AQI and forecasting support
  - Recognizes mapping spatial surfaces of O3, PM2.5 (AIRNow)
- Emissions strategy development
  - Routine (operational) Evaluation of Air Quality Models
  - Source apportionment/observational analysis
- Accountability of emissions strategy implementation (and trends)
  - Including risk assessments of national HAPs and visibility
- Basic infrastructure "core" for national exposure and epidemiological assessments to support NAAQS development
- Development of spatially coherent emissions strategy regions
- Evaluating methods through collocation

Note: a very broad array of data uses and sub objectives are imbedded

Other National Objectives/categories
[draft]

[beyond traditional scope of Grantee efforts; linkage needed]

- *Ecosystem assessments*
- *Global issues*
- *Research..diagnostic level*

Clear bi directional benefits, linkages…

Discussions started with CENR /AQRS

…NOAA, NPS, USFS, NARSTO, CASTNET, IMPROVE…

NCore does not address [draft]

- Isolated regulatory issues (few remaining CO, $SO2$, PM10*)
- Local/small community exposure/information
- Local "hot spot" air toxics issues
  - This is the major component of the air toxics monitoring program
- Intensive field campaigns for diagnostic model evaluation, risk assessment, personal exposure, detailed health studies.

Proposed Design approach [draft]

- Start with “reasonable” coverage from health/exposure perspective
  - Assume coverage emphasizing urban locations of various magnitudes (mostly large) with varying chemical composition
  - Assumes need for ***multiple pollutants*** to tease out confounding factors

- Add in necessary coverage for spatial needs (mapping and regulatory) for PM2.5 and ozone

- Add in desired rural coverage for accountability (major national programs such as 3P, NOx SIP) and model evaluation

- Identify common parameters and locations throughout to flesh out or prioritize “core” parameters and locations.

- Determine ability of existing networks to address, modify as needed

NCore would provide a new *collocated multiple pollutant component* to routine networks, and assumes: [draft]

- The regulatory and science communities support multi-pollutant measurement platforms; e.g.
  - Modelers/source apportionment …more rigorous evaluation/operation
  - Exposure/health science communities…delineate confounding factors
  - Monitoring community….to streamline operations and inter compare instruments

- New emphasis on gaseous C,N,S representative measurements for non regulatory use

Suggested Measurement List [draft]

- Master (perhaps only at a few selected (mini-SS locations)
  - Continuous
    - PM2.5, PM10, O3, CO, SO2, NO, NOy*, TNMOC, HCHO, light scattering, light absorption, basic meteorology, speciated VOC
    - Technology permitting: HCHO, HNO3, NH3, NO2, aerosol (C,N,S), PM size distribution
  - Integrated (filter, canister, denuder)
    - HNO3, NH3
    - PM2.5, SPECPM2.5 (as in IMPOVE, urban trends sites)
    - HAPS trends (TBD…e.g., HCHO, acrolein, metals (2-4??), benzene)

  - Color key: HCHO (toxics, PM, O3); NO (PM, O3); light absorption (PM, HAPs)

Measurement list, cont. [draft]
[~ site numbers]

- Multi pollutant sites
  - Master species …..~ 5 - 10 selected urban; (rural??)
    - Mini supersites
  - Core multi pollutant (several (50-100) urban/rural sites)
    - O3, PM2.5, No/Noy/Nox, CO, SO2, light scattering
  - Urban
    - Core plus specPM
  - Rural
    - Core
    - Maximize use of IMPROVE, other specPM sites

Linkage to Continuous monitoring

- Direction set by NMSC
- Network assessments identify redundant and FRM removal candidates
  - Resource pool
- Revisiting of monitoring objectives, Greater emphasis
  - on public information
  - Support health studies
  - Characterization for modeling..
- Regulations modification

Continuous monitoring plan
[introductory notes]

- Internal OAQPS team
  - Lee Byrd, Shelly Eberly, Tim Hanley, Mike Papp, Rich Scheffe
- Objective
  - Maximize utility of PM mass (integrated and continuous) data
- Process
  - Flexible, but
  - Complicated
- Recognizes
  - Practical need for integration with vast FRM network
    - Not mistaken as a particular measurement process as “better”
    - Intrinsic value of cont. measurements that measure different aerosol properties
  - Balance
    - Controlling data quality
    - Injecting various methodologies

Summary of Issues

- Complex plan…
  - Communications and implementation obstacles?
- “forcing” measurements to be FRM like
- Transformation guidance
- Consequences of future poor performance?
- Performance demonstrations
  - Roles of agencies and vendors…different
- Definition of regionality
  - Reconciling technical/scientific considerations, with
  - Pragmatic concerns…
- Possible disincentive to methods improvements
  - Use of transformations
- Emphasis on annual standard
  - Implications for daily??